

Appl. No. 10/635,779
Amendt. dated March 16, 2005
Reply to Office Action of December 16, 2004

REMARKS / ARGUMENTS

By the above amendments to independent claim 1 and dependent claims 15 and 16 and by cancellation of claims 17 - 27, it is respectfully urged that concerns raised in a First Office Action of December 16, 2004 have been addressed and resolved. Reconsideration and allowance of the specification and amended and pending claims are hereby requested.

I. INVENTION OVERVIEW

The invention is a hydrogen passivation shut down system for a fuel cell power plant. An anode flow path is in fluid communication with an anode catalyst for directing hydrogen fuel to flow adjacent to the anode catalyst, and a cathode flow path is in fluid communication with a cathode catalyst for directing an oxidant to flow adjacent to the cathode catalyst of a fuel cell. A hydrogen reservoir is secured in fluid communication with the anode flow path for receiving and storing hydrogen during fuel cell operation.

Upon shut down of the plant, a hydrogen transfer valve is opened to selectively permit hydrogen fuel to transfer between the anode flow path and the cathode flow path. Also upon shut down, the hydrogen reservoir releases the stored hydrogen into the fuel cell and after a hydrogen inlet valve prohibits flow of hydrogen fuel into the anode flow path from a hydrogen fuel source, the hydrogen reservoir continues to release hydrogen into the anode flow path and through the hydrogen transfer valve into the cathode flow field. Maintaining hydrogen within the anode and cathode flow paths during shut down of the plant minimizes oxidation of fuel cell components.

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II. RESPONSE TO OFFICE ACTION

In the First Office Action of December 16, 2004, the Examiner has first required affirmation of an election to prosecute Invention I, of claims 1 - 16. By this Amendment, applicants hereby affirm that election, and claims 17 - 27 have been canceled.

Next, at section 7 of the Office Action, the Examiner has required amendment of the specification to correct an informality, and by this Amendment, the typographical error on page 10, line 21 has been corrected. The undersigned thanks the Examiner for his attention to detail.

At section 8, the Examiner has rejected claim 15 under U.S.C. 112 second paragraph, because the recitation of a "sensor circuit" being "secured in electrical communication with the anode catalyst and cathode catalyst" includes no structure to facilitate the connection. By the present amendment, claim 15 has been amended to indicate that the "sensor circuit (80) is secured in electrical communication with an external circuit (82), which external circuit (82) is secured in electrical communication with the anode catalyst (14) and the cathode catalyst (16)...." (The amendatory language is underlined.) Antecedent basis for that amendment of claim 15 is found in Figure 1, with respect to the relationship of the "sensor circuit (80)", the "external circuit (80)", and the anode and cathode catalysts (14, 16). Additional antecedent basis for the sensor circuit being secured through the external circuit in electrical communication with the anode and cathode catalysts is found in the specification at page 15, lines 8 - 11 ("the hydrogen

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sensor means may be a hydrogen sensor circuit 80 secured in electrical communication with the cathode catalyst 14 and anode catalyst 16 of the fuel cell, such as through an external circuit 82."), page 15, lines 27 - 30, and page 16, lines 29 - 31, which recites: "The electrons flow from the anode catalyst 14 to the cathode catalyst 16 through the external circuit 80 to power the primary load".

In sections 9 - 11, the Examiner has next rejected claims 1-2, 7, 9, 13 and 16 under 35 U.S.C. 102(e) as being anticipated by U.S. Pre-grant publication No. 2004/0126628 (now U.S. Patent No. 6,838,199, issued to Balliet et al. on Jan. 4, 2005), hereafter "Balliet et al." The Examiner urged that Balliet et al. teaches all of the elements of the rejected claims, and in particular, all of the elements of the sole pending independent claim, claim 1. Of the element of claim 1 entitled a "hydrogen reservoir means", the Examiner stated at section 11: "Balliet et al. teaches...a hydrogen reservoir means secured in fluid communication with the anode flow path (paragraph [0022]). The examiner notes that the hydrogen fuel source disclosed in Balliet et al. is in fluid communication means with the anode flow path as shown in figure 1 by 40 and 54." What is disclosed in paragraph [0022] of Balliet et al., at reference numeral 40 is "a hydrogen containing reducing fluid fuel source 40", and at paragraph [0023], it is pointed out that a "hydrogen fluid inlet line 54 is secured in fluid communication between the fuel source 40 and the anode flow field 28".

While the undersigned acknowledges that the hydrogen fuel source 40 and inlet line 54 of Balliet et al. provide hydrogen fuel to an anode flow path, the "hydrogen reservoir means" of the present application includes different structures that perform a totally

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different function. As recited in the original claim 1, the "hydrogen reservoir means is secured in fluid communication with the anode flow path (24) for storing the hydrogen fuel whenever the hydrogen inlet valve (52) is open ... and for releasing hydrogen fuel into the anode flow path (24) whenever **the hydrogen inlet valve (52) is closed.**" (Emphasis in bold added.) The hydrogen source of Balliet et al. is not capable of releasing hydrogen fuel into the anode flow path when the "reducing fluid inlet valve 60" of Balliet et al. is closed because the inlet valve 60 of Balliet et al. is secured between the hydrogen fuel source and the anode flow field 28 of the Balliet et al. fuel cell. As recited in Balliet et al., in paragraph [0023], the "reducing fluid inlet valve 60" is for "selectively permitting or terminating flow of hydrogen containing reducing fluid through the anode flow field 28." Therefore, if the inlet valve 60 of Balliet et al. is shut off, flow of hydrogen from the fuel source 40 into the anode flow path 28 is terminated.

In contrast, the "hydrogen reservoir means" of the present invention is specifically for supplying hydrogen fuel to the anode flow path "whenever the hydrogen inlet valve (52) is closed." (Application at claim 1.) As recited repeatedly within the specification, this is a key element of the present invention in providing a passive apparatus for supplying hydrogen fuel to the fuel cell during shut down without the danger of opening the main fuel source 54. For example, in the specification at page 3, lines 19 - 24 in the "Background Art" section describing problems of known shutdown systems, it is stated that: "active addition of hydrogen to fuel cells of a power plant while the plant is shut down and unattended presents significant safety issues where a system failure may lead to release of potentially flammable hydrogen concentrations out of the power plant." Consequently, the present invention solves

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that problem by providing for passive release into the fuel cell of hydrogen fuel while the main hydrogen storage supply is shut down by the closed hydrogen inlet valve 52.

It is urged that no such "hydrogen reservoir means" is shown in Balliet et al. However, the undersigned is concerned that the original language of claim may have characterized the structure of the "hydrogen reservoir means" with respect to the above quoted functional language, thereby giving rise to a possible ambiguity. Therefore, to further clarify the distinction of the present invention over Balliet et al., claim 1 has been amended to recite that the "hydrogen reservoir means" is "secured between the hydrogen inlet valve (52) and an anode exhaust valve (32) secured to the anode flow path (24), the hydrogen reservoir means being secured in fluid communication with the anode flow path (24) for storing the hydrogen fuel whenever the hydrogen inlet valve (52) is open . . . , and for releasing hydrogen fuel into the anode flow path (24) whenever the hydrogen inlet valve (52) is closed." (The amendatory language is underlined.) This amendment clearly distinguishes the "hydrogen reservoir means" of the present invention from the "hydrogen reducing fluid fuel source 40" of Balliet et al.

Antecedent bases for the present, described amendment to Claim 1 is found in Figure 1, wherein one embodiment of the "hydrogen reservoir means", the "hydrogen vessel 66" is shown as secured between the hydrogen inlet valve 52 and the anode exhaust valve 32, as described in the specification at page 12, lines 20 - 26. Additional antecedent basis is found in the specification at page 13, lines 8 - 14. Also, in the specification at page 16, line 32 - page 18, line 33, use of the present invention is described in shutting down the fuel cell. In particular, at page 18, line 10 -

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6 - 17, operation of the hydrogen reservoir means with respect to the hydrogen inlet valve is described.

"Whenever the hydrogen sensor means determines that the concentration of hydrogen within the anode flow path 24 and cathode flow path 38 is about one-hundred percent (100%) hydrogen, the anode exhaust valve 32 and cathode exhaust valve 46 are closed, the hydrogen inlet valve 52, oxidant inlet valve 56, and cathode recycle valve 72 are also closed, while the hydrogen transfer valve 64 remains open. Hydrogen stored within the hydrogen reservoir means may then be passively released to maintain an elevated hydrogen concentration within the anode flow path 24 and cathode flow path 38 during shut down of the fuel cell power plant 10. (Emphasis added.)

To perform such a function, the hydrogen reservoir means must be secured between the hydrogen inlet valve 52 and the anode exhaust valve 32, as shown in FIG. 1, and described above in the specification. Additionally, as further antecedent bases for the amendment, other embodiments of the hydrogen reservoir means are shown in the specification at page 12, line 27 - page 13, line 8, including: "the hydrogen reservoir means may be in the form of hydrogen storage media, such as hydrides that are secured within the anode flow path 24, such as by a coating. Additionally, the hydrogen storage media may be applied as a coating of pores of the porous anode substrate layer 20, so that hydrogen fuel is stored within the storage media as the fuel flows through the anode flow path 24. Also, the hydrogen vessel 66 may include hydrogen storage media within the vessel 66. The hydrogen storage media may also be in the form of a coating of inlet or exhaust manifolds defined

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within the anode inlet 26 or anode exhaust 30 so that the hydrogen storage media is in fluid communication with the hydrogen fuel passing through the anode flow path 24. The hydrogen storage media of the hydrogen reservoir means may also be a coating within the anode flow field 28 exposed to the hydrogen fuel." (Emphasis added". Again and for purposes of clarity, all of the recited forms of the hydrogen reservoir means are secured "between the hydrogen inlet valve 52 and the anode exhaust valve 32".

As recited in the Manual of Patent Examining Procedure ("M.P.E.P.") at Section 2131 "To anticipate a claim, the reference must teach every element of the claim." Nothing in Balliet et al. shows or suggests any structure that is secured between the hydrogen inlet valve and exhaust valve that is therefore capable of performing the important function described above of applicants' "hydrogen reservoir means" as now claimed. Because Balliet et al. does not teach the "hydrogen reservoir means" of the present invention as now claimed, it is respectfully requested that Balliet et al. be removed as a reference for purposes of the Examiner's Section 102(e) rejection.

Next, at sections 12 - 17 of the First Office Action, the Examiner has rejected claims 3 - 5 under 35 U.S.C. 103(a) as being obvious over Balliet et al. in view of U.S. Patent 6,589,312 to Snow et al. The Examiner urges that Balliet et al. shows all of the limitations recited in his Section 102(e) rejection. However, as demonstrated above, Balliet et al. fails to show a key element, and hence it is again urged that Balliet et al. be removed as a reference, thereby resolving that rejection.

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Similarly, in Sections 18 - 22 the Examiner has rejected claim 14 under 35 U.S.C. 103(a) as being obvious over Balliet et al. in light of U.S. Patent No. 6,635,370 to Condit et al. Applicants urge that Balliet et al. should likewise be removed as a reference for this rejection as well, for the reasons recited above. Moreover, because these dependent claims simply limit what is urged to be a now allowable claim 1 as amended, it is urged that the rejections of these dependent claims be removed as well on this basis.

At section 23, the Examiner has indicated that dependent claims 6, 8, and 10 - 12 would be allowable if rewritten in independent form including all of the limitations of their base and intervening claims. However, because independent claim 1 as amended is urged to be allowable as described above, amendments to those claims are not necessary.

As discussed between the Examiner and the undersigned on December 7, 2004 in a telephone conference, by the present Amendment, claim 16 has also been amended to correct an inadvertent typographical error, wherein the word "causes" was omitted from claim 16, and has now been added. Antecedent basis for that amendment is found in the specification at page 17, lines 8 - 14.

III. CONCLUSION

It is submitted that the only remaining independent claim 1, as amended herein, clarifies the scope of claim 1 and clearly distinguishes the claimed invention over the Balliet et al. Therefore, the substantive concerns of the Examiner described in the First Office Action have been resolved. Additionally, informalities

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have also been remedied. Therefore, by the present Amendment, the Application is believed to have been placed in condition for allowance. Accordingly, it is respectfully requested that a Notice of Allowance be issued.

Respectfully submitted,
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